

### 3.1 Field Testing the Advanced Worker Protection System

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#### Abstract

The Advanced Worker Protection System, a revolutionary technology to provide breathing gas and body cooling to workers in a hazardous environment, has completed design development and is on the point of low rate production of a commercial product. Laboratory testing during the summer of 1997 demonstrated the AWPS's ability to supply air in sufficient quantities at all work rates, to operate in all orientations, to cool the user for up to two hours, and to protect the user from the environment without encumbering his ability to do work. In October, 1997, the final design of the AWPS was field tested at the facilities of the International Union of Operating Engineers (IUOE) in Las Vegas, Nevada.

The AWPS consists of three major subsystems that were tested at the IUOE facility:

- A liquid air backpack. This is a self-contained breathing apparatus which is worn on the back. The backpack stores breathing air as a cryogenic liquid and exchanges the cooling power of the cryogen with water that transports body heat from the worker. The backpack is equipped with a patented pivoting pick-up mechanism that can draw out the liquid if the worker is standing, crawling, lying on his back or side, or even inverted. Three backpacks were tested: two had the capacity to provide up to two hours of breathing and cooling; the third, with only one hour capacity, had a smaller profile for use in confined spaces.
- A liquid cooling garment. This revolutionary cooling garment has made major strides in wearability, washability, comfort, and cost by conducting cooling water over the user's muscles through a combination of plastic patches rather than tubes exclusively. The garment itself, made of a cotton-lycra fabric, is provided with pockets that hold the coolant patches in a way that allows free movement during vigorous activity or washing.
- A Level B splash suit. To accommodate the backpack and cooling garment, the AWPS uses a custom-designed, two piece splash suit which has high mobility, good conformance to the backpack shape, good visibility, and the requisite splash protection. Innovations in this splash suit include a glove ring, a conformal shape which encloses the bottom of the backpack, and an optional caribener pass-through for use with a lifting or safety harness.

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Workers filled, donned, operated, and stowed the AWPS equipment without assistance from the development engineers. Testing at the IUOE facility subjected the AWPS to a series of tests that represent the major tasks performed by hazardous material clean-up workers. These include:

- Moving material in a wheelborrow.
- Moving liquids with buckets.
- Crawling through a horizontal confined space.
- Heavy equipment decontamination
- Operating heavy equipment.
- ▶ Worker decontamination protocols.

During the testing, various physiological functions were monitored. Questionnaires were distributed to capture subjective comments on the performance, operation, and use of the AWPS. Problems were identified.

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